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ABSTRACT

One of our eight national education goals is that by the year 2000, U.S. students will be first in the world in mathematics and science achievement. The Third International Mathematics and Science Study results have shown that we are far away from attaining this goal. This article highlights the need to reform a teacher preparation program in order to enable students to reach the goal of being the first in the world in mathematics and science achievement. A well trained teaching force is very crucial for high student achievement. (Contains 20 references.) (YDS)

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Third International Mathematics And Science Study (TIMSS):

Reforming Teacher Preparation Program To Improve Student Achievement

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Abstract

One of our eight national education goals is that by the year 2000, U.S. students would be first in the world in mathematics and science achievement. The Third International Mathematics and Science Study results have shown that we are far away from attaining this goal. In this article, Benjamin Ngwudike highlights the need to reform our teacher preparation program in order to enable our students reach the goal of being the first in the world in mathematics and science achievement. A well trained teaching force is very crucial for high student achievement.

The importance of math and science in the scientific and technological development of United States cannot be overemphasized. The same is true of U.S. military capability, and the economic and social advancement of its people. It has become a well documented fact that American students are performing below their peers from other industrialized countries on math and science achievement tests.

Student achievement is largely dependent on good teachers. Good teachers are products of good teacher education program. Without teachers that are knowledgeable in subject matter and education, U.S. students may continue to perform below their peers internationally. To ensure knowledgeable teachers for our students, we need to reform our teacher preparation program.

A few years ago a researcher compared the math performance of 24,000 13-year-old students from the United States and five other countries. Korean students came in first and the American students came in dead last (Colson, 1996). This poor performance by American students should be the concern of every person interested in the future of the United States. Math and science, and education in general, are very crucial for U.S. continued edge over its competitors. U.S. needs to invest heavily in math and science education.

Nowhere will any forward-thinking and long-term investment reap greater benefits than in education - particularly in the fields like math and science, which are so crucial to our individual and national success. Knowledge in these fields is not just for future scientists and mathematicians. It is a critical base for a wide variety of careers and for learning generally (Riley, 1999).

During 1994 -1995 school year, half a million fourth, eight, and twelfth grade students from 41 countries took a comprehensive examination. The test known as the Third International Mathematics and Science Study (TIMSS) evaluated and compared the math and science skills of students internationally. The results of the first phase of the study were released in November 1996 with some disappointing numbers for U.S. students. The U.S. students did not rank near the top in either math or science skills. The U.S. students scored below average in math achievement (Gallagher, 1997).

The Third International Mathematics and Science Study (TIMSS) is the largest and most comprehensive comparative international study of education that has been undertaken. A half-million students from 41 countries were tested in 30 different languages at five different grade levels to compare their mathematics and science achievement. Intensive study of students, teachers, schools, curriculum, instruction, and policy issues were also carried out to understand the educational context in which learning takes place (National Center for Education Statistics (NCES), 1996). For the avoidance of doubt, the grade levels tested correspond to fourth, eight, and twelfth in the United States

The countries that participated in TIMSS are: Australia, Austria, Belgium (Flemish), Belgium (French), Bulgaria, Canada, Colombia, Cyprus, Czech Republic, Denmark, England, France, Germany, Greece, Hong Kong, Hungary, Iceland, Iran (Islamic Republic), Ireland, Israel, Japan, Korea, Kuwait, Latvia, Lithuania, Netherlands, New Zealand, Norway, Portugal, Romania, Russian Federation, Scotland, Singapore, Slovak Republic, Slovenia, South Africa, Sweden, Switzerland, Thailand, and the United States (NCES, 1996). TIMSS is an important study for those interested in U.S. education.

TIMSS comes at a time when mathematics and science achievement has been designated as education priority. One of our eight current National Education Goals is that by the year 2000, United States students would be first in the world in mathematics and science achievement. In addition, mathematics and science experts have issued major calls for reform in the teaching of their subjects. The National Council of Teachers of Mathematics published Curriculum and Evaluation Standards for school mathematics in 1989, and Professional Standards for Teaching Mathematics in 1991. In 1993, the American Association for the advancement of Science followed suit with Benchmarks for Science Literacy, and in 1996, the National Academy of Sciences published National Science Education Standards. All these measures are geared toward improving the performance of U.S. students in mathematics and science achievement internationally (NCES, 1998).

The problem of poor performance on math and science in the U.S. started to surface in the late fifties with the launching of the Russian Sputnik. On November 13, 1957, President Eisenhower in a television address told the nation that the reason U.S.S.R. had a space satellite and the United States did not was that the U.S.S.R. was able to produce 80,000 engineers to our 30,000 and that their educational system emphasized math, science, and engineering. Eisenhower called on Congress to expand the National Science Foundation and requested the enactment of special education programs in math, science, and engineering (Moyniham, 1975). It was the launching of the Russian Sputnik that spurred the passing of the National Defense Education Act in 1958 by Congress. This act has helped to put U.S. in the forefront of space race because it emphasized the teaching and learning of math, science, and technology.

The U.S. schools are again failing in the core academic mission, particularly in the more

rigorous areas of study - math and science - so crucial to the future of sophiscated technology and international competition (Chubb & Moe, 1990). If this trend is allowed to continue, the U.S. will be risking its world supremacy. Despite the breakup up of the U.S.S.R., Russian Federation and China still pose future threat to U.S. supremacy. For U.S. to guaranty its continued world supremacy, American students need to be first in the world in mathematics and science achievement. This is one of our eight National Education Goals. The attainment of this goal is very crucial for U.S. continued supremacy.

Quite simply, if we do not work to ensure that we have the intellectual power that has helped us become the world leader we are today, we can be sure that we will not have the capacity to be leader of tomorrow (Riley, 1999).

However, TIMSS results show that U.S. students are lagging behind their peers in mathematics and science achievement. One of the ways of addressing this trend is for U.S. to reform its teacher preparation program. United States needs first class world teachers if our students will be first in the world in mathematics and science achievement. Students cannot rise above the level of their teachers. United States needs to make its teacher preparation program a top priority if our students are to meet our national education goals.

If we do not focus as a nation on preparing excellent teachers and providing them with quality initial preparation, professional development, and supportive working conditions - then we will fall short of our goals for students. These are issues of critical national importance - even national security (Riley, 1999).

Teacher education has long been considered weak among higher education degree programs, one that lacks high standards and strong contacts with the field. Now, however,

teacher education programs are being improved in many colleges and universities through a variety of efforts. These include: revised, challenging standards for accreditation of teacher education; the growth of professional development schools; and emphasis on a deeper knowledge base for prospective teachers as well as demonstration of competence. However, much remains to be done (National Council for the Accreditation of Teacher Education [NCATE], 1998).

The above description of teacher preparation programs in our colleges and universities is agonizing. Teacher preparation needs to reflect excellence. Colleges and universities need to make their teacher preparation programs more rigorous and demanding. The standard for admission to teacher preparation programs should be toughened. When the standard of admission is lowered, the standard of the final product - the teachers sent to the classrooms to teach - is equally lowered. United States students cannot be first in the world in mathematics and science without knowledgeable and competent teachers.

Even more important, critics of teacher education and reformers of public schooling agree that the preparation of teachers must be substantially stronger. If students are expected to know more and be able to apply their knowledge skillfully, then teachers must be models of such learning (NCATE, 1998).

For many decades the United States education system has tried to improve student achievement by tinkering with various levers in the great machinery of schooling: New management schemes, curriculum packages, testing, policies, centralization initiatives, decentralization initiatives, and a wide array of regulations and special programs have been tried, all with the same effect. Reforms, we have learned over and over, are rendered effective or ineffective by the knowledge, skills, and commitments of those in schools. Without know-how

and buy-in, innovations do not succeed. Neither can they succeed without appropriate supports, including such resources as materials, time, and opportunities to learn (Hammond & Ball, 1997).

Today, research is confirming what common sense has suggested all along: A skilled and knowledgeable teacher can make an enormous difference in how well students learn. Such findings make sense to the public: Nine of 10 Americans say that ensuring a well-qualified teacher in every classroom is the second most important step that could be taken to lift student achievement, outranked only by ensuring school safety, according to a 1998 public opinion poll conducted by Recruiting New Teachers, a nonprofit organization in Belmont, Massachusetts (Olson, 2000).

Furthermore, studies discover again and again that teacher expertise is the most important factor in determining student achievement, followed by the smaller but consistently positive influences of small schools and small class sizes. That is, teachers who know much about teaching and learning and who work in environments that allow them to know students well are the critical elements of successful learning. How does teachers' expertise affect student learning? Teacher expertise - or what teachers know and can do - affects all the core tasks of teaching. For example, what teachers understand, both about content and students, shapes how judiciously they select from texts and other materials and how effectively they present materials is class. Their skill in assessing their students' progress depends also on how deeply they themselves know the content, and how well they can understand and interpret students' work. Nothing, can fully compensate for the weakness of a teacher who lacks the knowledge and skill needed to help students master the curriculum (Hammond & Ball, 1997).

NCATE insists that its accredited schools ensure that their teacher candidates know the

subject matter content they plan to teach and how to teach it effectively. On the ETS PRAXIS II licensing exam (which measures content knowledge) administered in 37 states to 270,000 candidates between 1995 and 1997, those individuals who enrolled in teacher preparation programs and who had a concentration or a major in a subject area scored highest. This occurred in every major subject matter tested - mathematics, science, English, social studies. Those individuals who never enrolled in teacher preparation scored lowest (NCATE, 1997).

Teachers' expertise (as measured by teacher education, scores on a licensing examination, and experience) accounted for far more variation in students' achievement than any other factor (about 40 % of the total), and that every additional dollar spent on more highly qualified teachers netted greater increases in student achievement than did any other use of school resources (Ferguson, 1991).

Ferguson's findings closely mirror those of a recent review of 60 studies which found that teacher education, ability, and experience, along with small schools and lower teacher-pupil ratios, are associated with significant increases in student achievement. In their estimate of achievement gains associated with various uses of funds, additional spending on teacher education outweighed other variables as the most productive investment for schools (Greenwald, Hedges, & Laine, 1996).

Many other studies have come to similar conclusions. A study of high- and low-achieving schools in New York City with similar student populations found that differences in teacher qualifications accounted for more than 90 % of the variation in student achievement in reading and mathematics in all grade levels tested (Armour-Thomas, Clay, Domanico, Bruno, & Allen, 1989). A Tennessee study of the effects of teacher on student learning found that elementary

school students who are assigned to ineffective teachers for three years in a row score fifty percentile points lower on achievement tests than those assigned to most effective teachers over the same period of time (Sanders & Rivers, 1996).

Another body of research confirms that teacher knowledge of subject matter, student learning and development, and teaching methods are all important elements of teacher effectiveness. Reviews of many other studies contradict the long standing myths that anyone can teach and that teachers are born not made. Teacher education as it turns out, matters a great deal. In fields ranging from mathematics and science to early childhood, elementary, vocational, and gifted education, teachers who are fully prepared and certified in both their discipline and in education are more highly rated and are more successful with students than are teachers without preparation, and those with greater training are found to be more effective than those with less (Ashton & Crocker, 1987; Evertson, Hawley, & Zlotnick, 1985; Greenberg, 1983).

Many countries are intensifying their programs of teacher preparation. Japan and Chinese Taipei are also moving toward extended programs of teacher preparation, including greater study of teaching and learning and an intensive internship. In Japan, for example, after graduating from a teacher education program and passing a highly competitive teacher appointment examination, beginning teachers work with a master teacher who observes them weekly. Their reduced load allows them to observe the classes of other teachers, participate in seminars and training sessions, and undertake 60 days of in-school professional development on topics such as classroom management, computer use, teaching strategies, and counseling methods (Hammond & Ball, 1997).

We cannot entrust our homes and health to professionals who are not certified and licensed.

On the same token, we should not entrust the education of our children to teachers who are not certified and licensed. The education of our children should be as important as our health and homes. Our policy makers have a duty to develop policies that will put teacher preparation programs in line with those of medicine and engineering.

A policy brief by the U.S. Department of Education (1997) recommended setting more meaningful standards for what teachers should know and be able to do at both preparation and certification stages; providing longer periods of learning and mentoring for new teachers; and raising teacher salaries to attract the best candidates. In many other countries, teachers enjoy high professional status and see themselves as having expertise they contribute to improving their profession.

Findings from the study of teacher beliefs and practices indicate that teacher preparation in the United States differs from that in most other countries: on a national level, U.S. teachers are not required to pass an examination to become certified to teach. Close comparison of the United States, Japan, and Germany reveals some interesting differences. Unlike U.S. teachers, teachers practicing in those countries must complete lengthy apprenticeships with mentor teachers before certification. Also, in Japan, practicing teachers have more formal and informal opportunities to interact with their colleagues than do teachers in Germany or the United States (Koca & McCann, 1999).

In many countries that might be thought of as U.S. peers or competitors, teacher preparation standards are similar to the standards obtained in medical and engineering professions. These standards include, but not limited to, long period of training, tough certification requirements, long period of closely supervised apprenticeship, and high pay.

Clearly, if students are to achieve high standards, we can expect no less from their teachers and other educators. Like many European and Asian countries, U.S. should support high-quality teaching by: Pegging teacher salaries to those of professions like engineers or civil servants so that teaching does not experience shortages of qualified personnel, subsidizing a rigorous program of teacher preparation so that the most talented candidates can be recruited, encouraging or requiring graduate preparation in education on top of a bachelor's degree, including at least a year-long internship in a school in partnership with the university, requiring rigorous examinations of knowledge about subject matter and teaching before entry into the profession, providing beginning teachers with intensive mentoring, support systems, and reduced teaching loads, so that they can gradually learn to teach proficiently, and building extensive time for learning and collective planning into teachers' schedules so they can work on teaching together (National Commission on Teaching and America's Future, 1996).

The goal that U.S. students should become first in the world in math and science achievement by the year 2000 should not be an empty boast. U.S. Students can become first in the world in math and science achievement if we can reform our teacher preparation program. A high-quality teaching force is the key to high student achievement. We have learned enough from TIMSS data. Now is the time for action.

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I am delighted to forward to you the enclosed article. Please review it for publication.

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